The Future of Unmanned Air Power

Technology Maturity - A Customer's Perspective

10 MAY 2006

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Presentation Overview

The Future of Unmanned Air Power

- **Background**
- **Technology Readiness**
- **Observations**
- **Summary**

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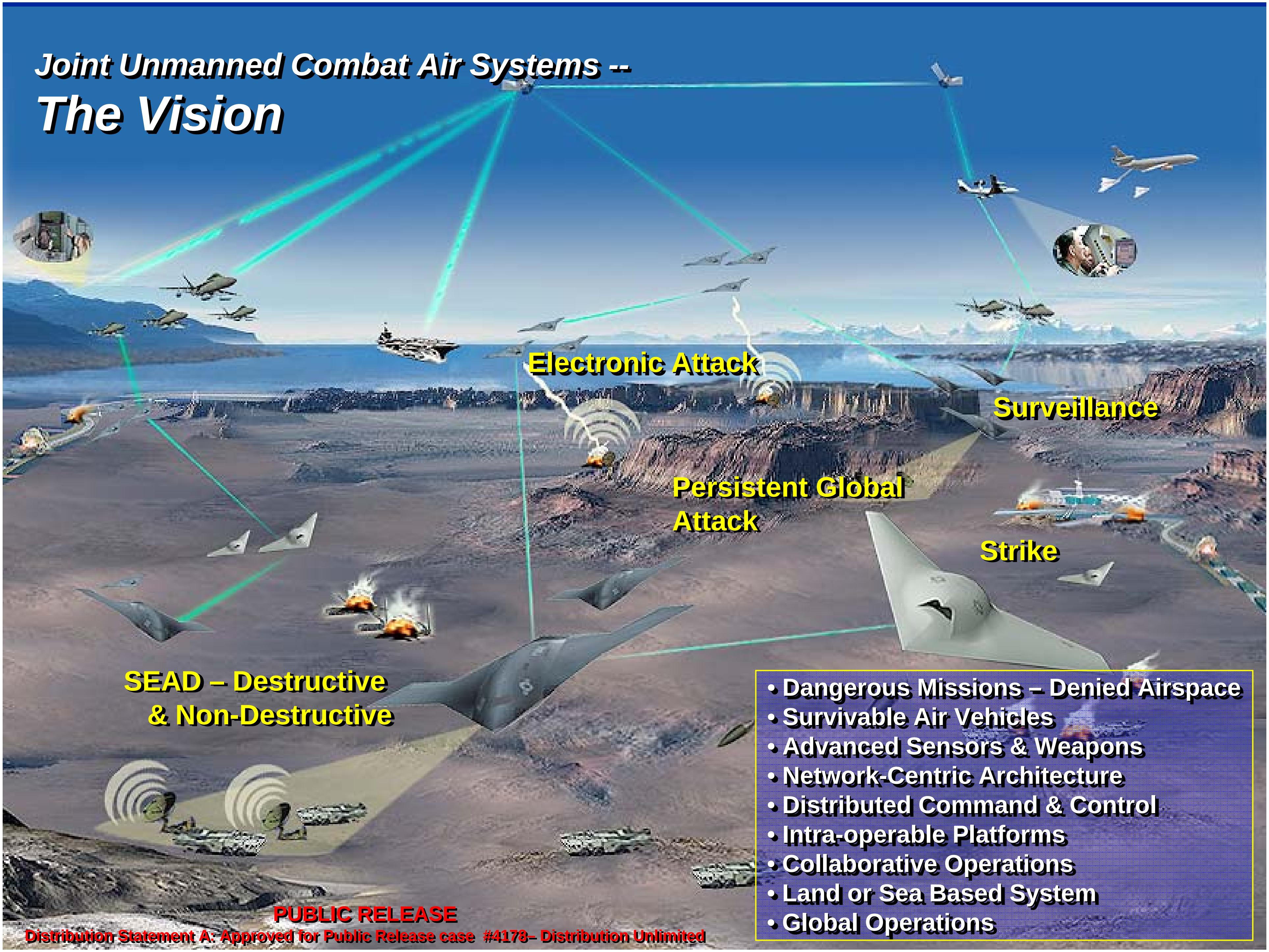
Joint Unmanned Combat Air Systems --
The Vision



- Dangerous Missions – Denied Airspace
- Survivable Air Vehicles
- Advanced Sensors & Weapons
- Network-Centric Architecture
- Distributed Command & Control
- Intra-operable Platforms
- Collaborative Operations
- Land or Sea Based System
- Global Operations

Demonstrator Air Vehicle Configurations

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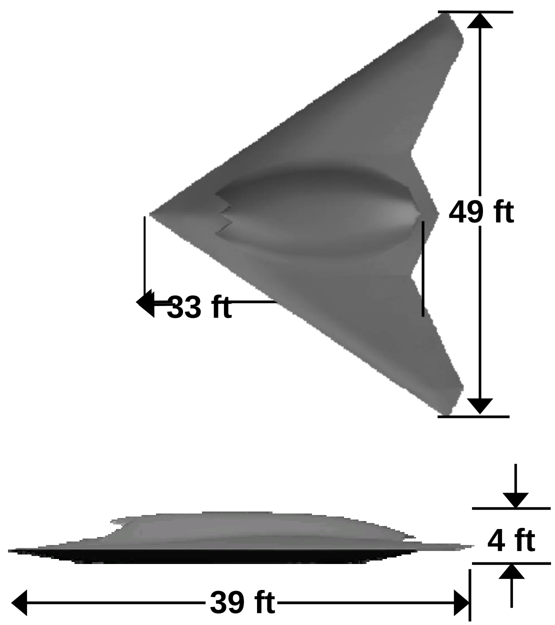
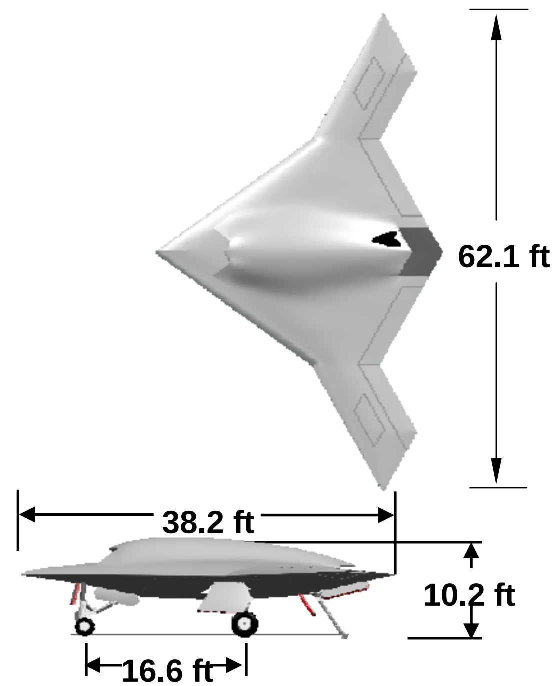
Boeing – X-45C



All numbers are approximate

Design Gross Weight:	36,500 lb
Op Empty Weight:	18,000 lb
Fuel Volume:	14,000 lb
Weapons Bay Payload:	4,500 lb
Operating Altitude:	40,000 ft
Cruise Mach:	0.8
Engine:	F404-GE-102D

Northrop Grumman – X-



Design Mission TOGW	48,000 lbs
Op Empty Weight	24,000 lbs
Fuel Volume	17,000 lbs
Weapons Bay Payload	4,500 lbs
Operating Altitude	43,000 ft
Subsonic Speed	460 KTAS
Engine	F100-PW-220U

J-UCAS X-45 System Features

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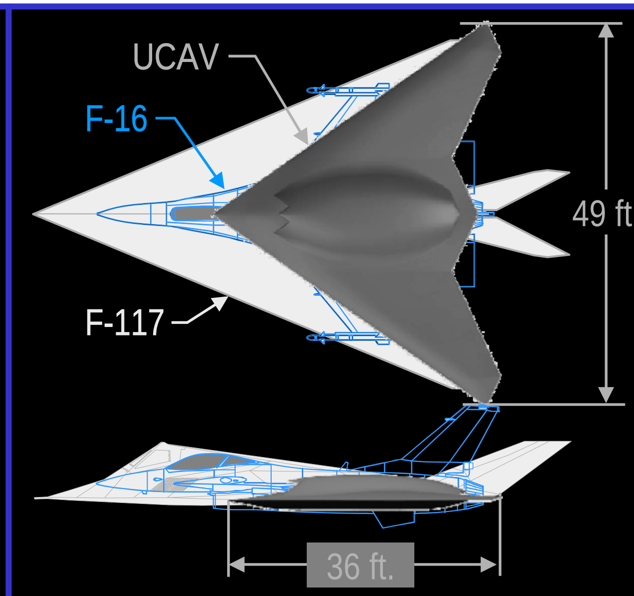
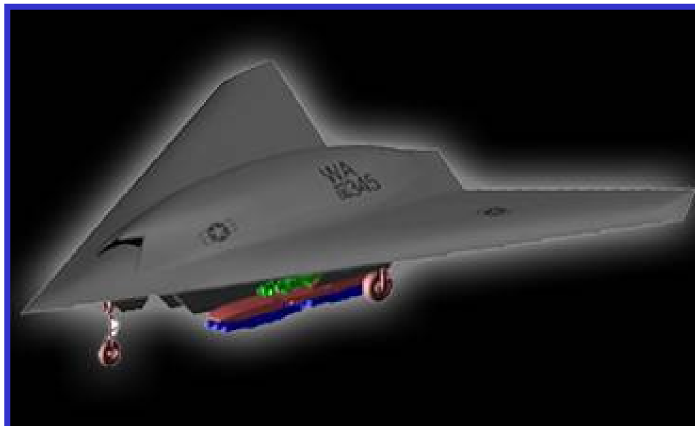
Mission Control Station

- Task Allocation by Phase of Mission
- Dynamic Mission Planning and Replanning
- Single Operator Controls Multiple Vehicles
- Robust secure LOS, BLOS and intra-flight C2
- Dynamic Distributed Control
- Multiple Levels of Autonomy
- Uses Theater and National Information Sources

Air Vehicle

- ~36,500 lb Gross Weight
- ~18,000 lb Empty Weight
- ~0.8 Mach / 40,000 ft altitude
- 1100-1300 nm combat radius
- Current and advanced weapons
- Electronic Attack (EA) Payloads
- ESM and On-Board SAR Targeting
- Affordable Stealth to the Next Level





Support System

- Supportable LO
- High Sortie Generation Rates
- No Hydraulics
- Simulation Based Training
- Lean Logistics
- Integrated Vehicle Health Management (IVHM)

Carrier Suitability

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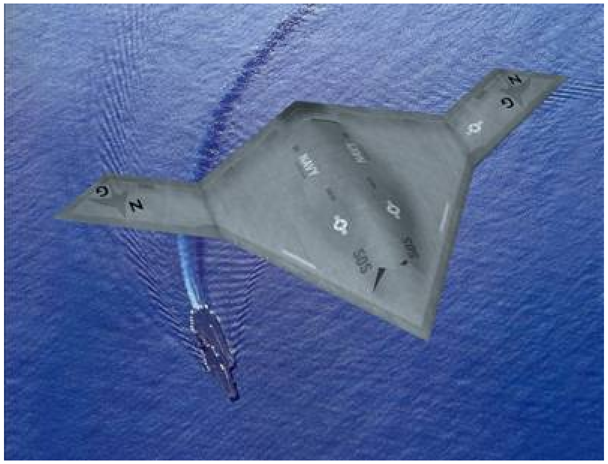
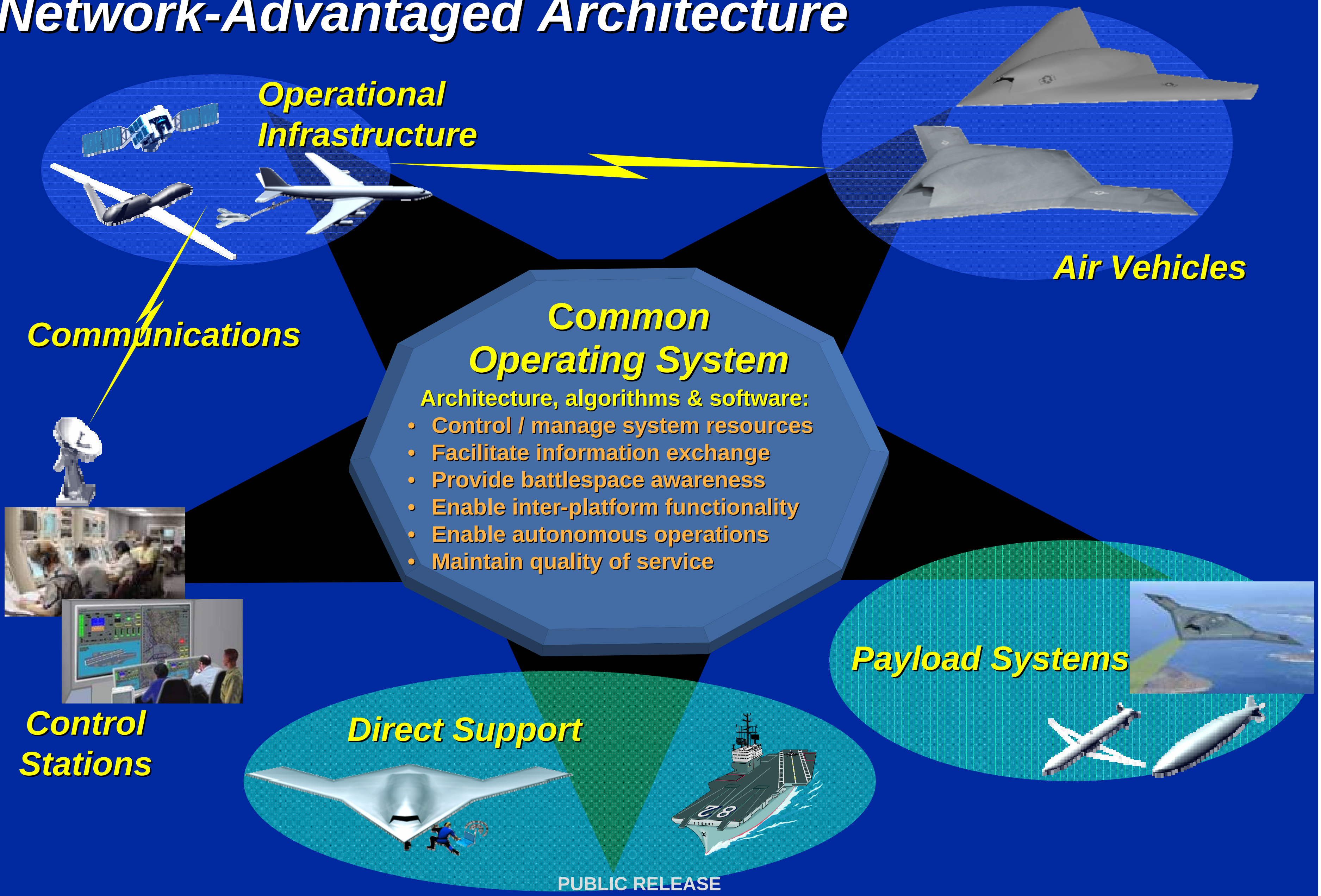


- **Navy's highest priority**
- **NGC X-47B AV1 and AV2 designed and built for carrier suit testing**
  - **Sea-based 'Cats & Traps'**
  - **Answered desire for 'At Sea' demo**
  - **CV demo complete in FY11**
- **Boeing X45C Program has option for CV variant**
  - **Not yet executed**

J-UCAS

Meeting the Challenge --

Network-Advantaged Architecture



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Joint Unmanned Combat Air Systems --

… 'Raising the Bar'

J-UCAS

Predator
Many : 1

Global Hawk
1 : 1

Operator : Vehicle Ratio

J-UCAS
1 : Many

Predator & Global Hawk
Secured Airspace
Land Based
Dissimilar Air Ops

Operational Environment

J-UCAS
Denied Airspace
Survivable Design
Land & Sea Based
Mainstream Air Ops

Global Hawk
Single Ship
Days

Mission Planning Time

J-UCAS
Multi Ship
Hours

Global Hawk
Dedicated Channel
per Vehicle
Large Bandwidth Blocks

Communication Management

J-UCAS
Shared Channels
Quality of Service
Net Ready

Fielded Systems
Single Ship Only
Stove-Piped Systems
No Cooperation

Cooperative Operations

J-UCAS
Multi Ship, Cooperative
Targeting & Attack
Interoperable

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Critical Technologies Evolution

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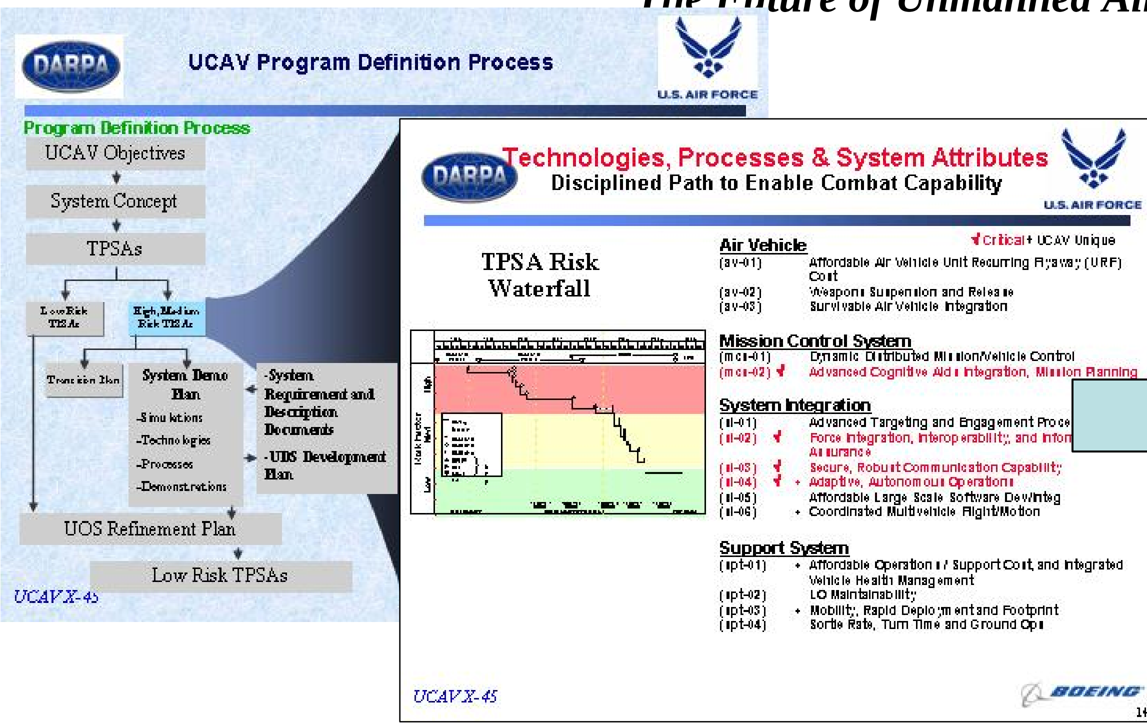

- ➢Signature Reduction
- ➢Secure Robust Communications
- ➢Force Integration, Interoperability, and Global Grid Compatibility
- ➢Multi-Vehicle Targeting
- ➢Adaptive Autonomous Operations
- ➢Operations on the carrier and in Carrier Controlled Airspace
- ➢Propulsion System
- ➢Autonomous Air Refueling

UCAV Technologies Processes & System Attributes

J-UCAS Critical Technologies

UCAV 1999-2003

J-UCAS 2004 -

Boeing X-45A Highlights

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- ☑ **X-45A First Flight – May 02**
- ☑ **Block 1 Complete – Feb 03**
  - ☑ **Envelope expansion**
- ☑ **Block 2 Complete – Aug 04**
  - ☑ **Link-16 C2 link & Inter-Vehicle Comm.**
  - ☑ **Guided Weapon Release**
  - ☑ **First Multi-Ship Flight**
- ☑ **Block 3 Complete – Feb 05**
  - ☑ **3-D/4-D Multi-Ship Demos (Nov 04)**
  - ☑ **SATCOM Handoff to SEA MCS (Dec 04)**
  - ☑ **FAO-AOR Handoff (Jan 05)**
  - ☑ **Peacekeeper Mission Demo (Feb 05)**
- ☑ **Block 4 Complete – Aug 05**
  - ☑ **Single and Multi-ship Dynamic Attack Planning (May and June 05)**
  - ☑ **AV/T-33 Surrogate Multi-Ship BLOS (July 05)**
  - ☑ **Multi-Ship PD-SEAD (Aug 05)**

Spiral 0 Complete

X-45A Flight Summary
- **64 Flights**
- **63.4 Flight hours**
- **124 T-33 Flights**

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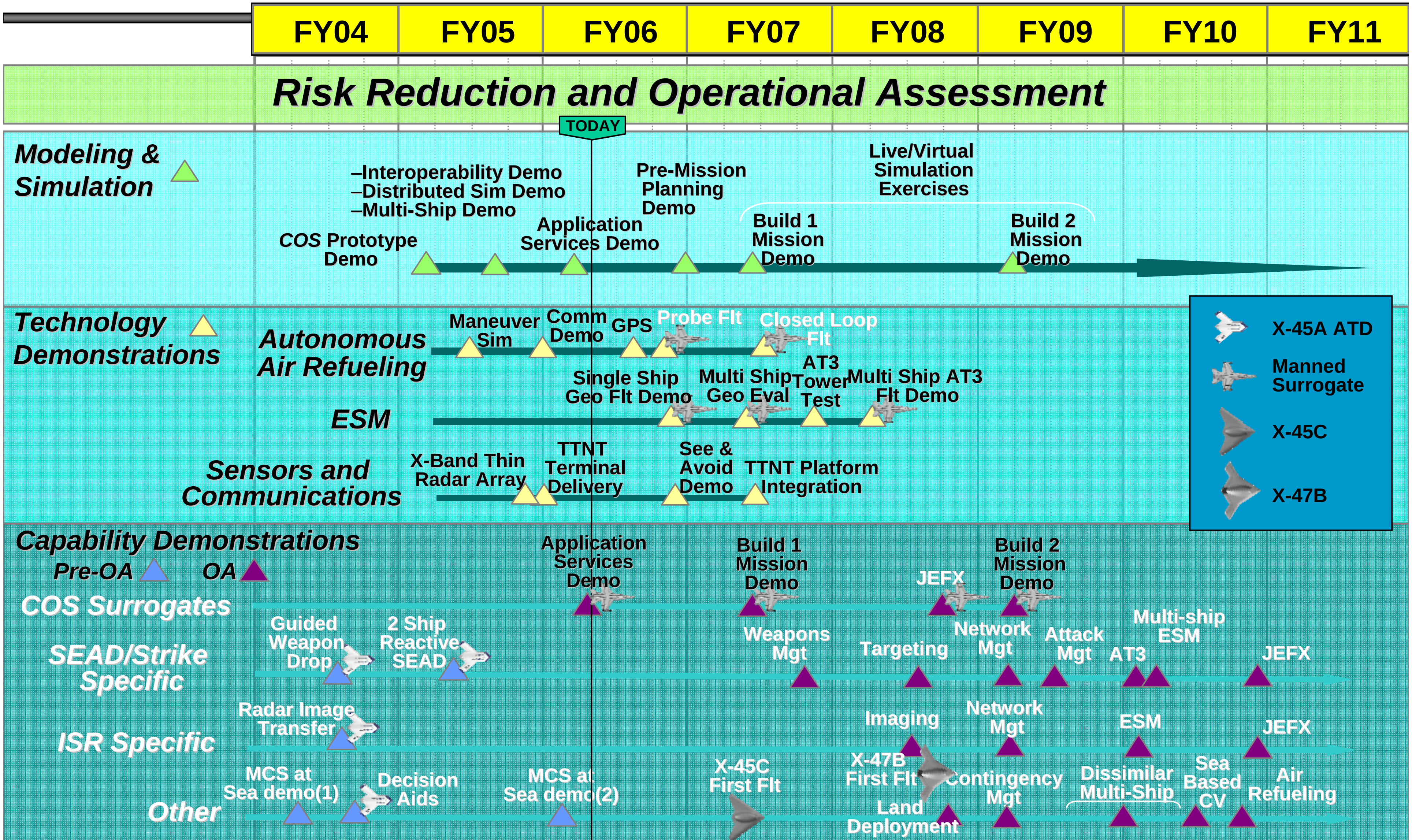
J-UCAS Initial Maturation Plan



AT3 – Advanced Tactical Targeting Technologies
ATD – Advanced Technology Demonstration
COS – Common Operating System
CV – Aircraft Carrier

ESM – Electronic Support Measures
ISR – Intelligence, Surveillance, and Reconnaissance
JEFX – Joint Expeditionary Force Exercise
MCS – Mission Control Station

OA – Operational Assessment
SEAD – Suppression of Enemy Air Defense
TTNT – Tactical Targeting Network Technology

J-UCAS TRL Summary
(JPO Assessment as of 6 JAN 06)
The Future of Unmanned Air Power

Technology	Current Level	2011 Level (Assuming J-UCAS Completion)
Signature Reduction	5	7
Secure Robust Communications	5	6.5
Force Integration, Interoperability, and Global Grid Compatibility	3.5	6.5
Multi-Vehicle Targeting	5	7
Adaptive Autonomous Operations	4.5	6
Operations on the carrier and in Carrier Controlled Airspace	4	6
Propulsion System	5	6
Autonomous Air Refueling	4	7

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Observations & Recommendations

- Technology Readiness Levels are the common language to communicate technical maturity to program stakeholders
  - Program Management
  - Decision Makers and Approval Authorities
  - Congress and the GAO
- Important to define a process and document all assumptions and constraints used in determining the technology readiness levels
- Technology Readiness Levels provide some but not all of what's needed in assessing a program's maturity. Other areas needing assessment-
  - Process Maturity Measures
  - Development Capacity (Software and Manufacturing)
  - Information Assurance

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- **MILS Drivers**
- **Observations**
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Summary

- **J-UCAS Program's technology push highlighted the importance of assessing technical maturity**
- **J-UCAS established processes and followed a plan to mature technologies**
- **Observations reinforced the importance of assessing technical maturity**